Moab Mill Site Stakeholders Meeting
November 20, 2003, 1:30 to 4:30 p.m.
Castlerock Inn, 815 South Main Street, Moab, Utah

Attendance*:

- Utah Department of Environmental Quality: Dianne Nielson, Bill Sinclair, and Loren Morton
- U.S. Fish and Wildlife Service: Henry Maddux, and Bruce Waddell
- National Park Service: Jerry Banta, Pete Penoyer, and Phil Brueck,
- Bureau of Land Management: Maggie Wyatt
- Environmental Protection Agency: Paul Mushovic
- Grand County: Harvey Merrell, Jim Salmon, Joette Langranese, Judy Carmichael, Judy Bane, and Rex Tanner
- University of Utah Department of Geology: Kip Solomon, and Phil Gardner,
- Department of Energy: Don Metzler, Wendy Ryan; Joel Berwick,; Toby Wright (MFG), and Ken Karp (Stoller), Tom Anderson
- Media: Lisa Church (Salt Lake Tribune), and Jon Korash (KZMU).
- General Public: Bill Love, Sarah Fields, John Darke

* Some individuals in attendance did not sign the attendance sheet.

1. Summary of Matheson Preserve Studies Since July 2003 (Kip Solomon and Phil Gardner, University of Utah Department of Geology) Powerpoint Presentation: Investigation of the Hydrologic Connection Between the Moab Mill Tailings and the Matheson Wetland Preserve

Goals of Study

- Further define the extent of channel gravels
- Investigate sources of recharge to the aquifer
- Determine the age of contaminated mill process water
- Investigate deep aquifer brine as lower boundary to shallow active aquifer
- Assemble baseline chemistry data from both sides of the river for one period of time

Methods Used

- Logged core from 3 new borings to look at subsurface lithology
- Water level and salinity data collected to map out hydraulic potentials
- Ground water (GW) sulfate and chloride concentrations sampled and analyzed
- GW ammonia and uranium concentrations sampled and analyzed
- Oxygen and hydrogen isotopes sample collected and analyzed
- Tritium and noble gases sampled and analyzed

Sampling Sites Sampled

Water samples collected from 44 sites on both sides of the river.

- 10 DOE monitoring wells from the mill tailings property
- 25 sites that existed previously on the Matheson Preserve
- 9 new monitoring wells in 3 new boreholes on Matheson Preserve (BL1, BL2, and BL3)

Lithology Found in New Borings (BL Series)

- Overbank deposits at surface = 5-6 meters (16 – 20 feet) of silt and sand
- Below the overbank deposits, large continuous packages (>40 meters [131 feet) thick) of gravel and cobbles deposited by Colorado River were found in borings BL1 and BL2.
- Scattered small channel deposits (~0.5 meter (1.6 feet) thick) found at BL3 within finer grained sediment
- Core samples and drilling refusal at a depth of about 31 meters (100 feet) suggests Paradox Formation caprock in boring BL3

Importance of Lithology (Deep River Gravel Deposit)

- Gravels-cobbles (>20 cm) often with sandy matrix
- Pink granites, mafic schists, diorite porphyry are evidence that deep gravels were deposited by Colorado River
- As a hydrogeologic unit, the deep gravel unit is much more permeable than the shallow overbank deposits

Extent of Colorado River Gravel Deposits

By combining new logs and DOE logs from 2002 drilling …

- Areal extent of deep river gravel deposits is >1.5 kilometers (~4,900 feet)
- Maximum thickness >40 meters (> 131 feet)

Cross Sections Prepared

- Used to display data distribution in the subsurface.
- Both cross-sections A-A' and B-B' drawn through Glen Canyon Group (GCG) water, contaminated mill site waters, and onto Matheson Preserve

Groundwater Salinity

- TDS in sampled waters range from 600 to 120,000 mg/L
- Most shallow groundwater on Matheson Preserve ~ 1,000 to 3,000 mg/L
- Deeper brine ~ 100,000 mg/L
- Intermediate depth groundwater shows strong salinity gradients

Shallow System Water Table Contours

- Represents hypothetical water table for a shallow system composed of all fresh water (equivalent freshwater heads [EFH])
- EFH data was interpolated from shallow piezometers where groundwater TDS <20,000 mg/L
- GW movement in shallow system generally toward river (both sides of river)

Deep System Potentiometric Surface (Shallow Brine)

- EFH values determined by interpolation at a 1,190 meter (3,904 ft) elevation in subsurface
- Compiled using EFH from deep well nests in channel gravel deposits
- All wells used had TDS >40,000 mg/L

- Gradients are small but brine movement is from NW to SE beneath the Colorado River and under the Matheson Preserve

Uranium

- Uranium ranged from <0.3 to 3,940 ug/L
- Below detection in two distinct places
  1. In brine at 90 and 120 meters (295 – 394 feet) depth in DOE ATP-1 well nest
  2. In shallow fresh water of Matheson N9 well nest
- Max levels in DOE SMI wells: 1,430 to 3,940 ug/L

Uranium Distribution

- Elevated uranium levels in groundwater beneath MWP near Colorado River
  -- 5.5 to 111 ug/L
  -- Decrease toward the SE
- Highest levels in wells screened below the top of the deep River Gravel Deposits and water with TDS > 40,000 mg/L
- Anomaly at Matheson well N3
- EFH in shallow brine suggest potential for uranium migration from mill tailings and beneath the river

GRAPHIC – **Oxygen and Hydrogen Isotopes**

GRAPHIC – **Distribution Oxygen Isotopes**

Tritium (^{3}H)

- Tritium is a radioactive isotope of hydrogen with a half-life of 12.3 yr
- Exists as part of water making it chemically non-reactive
- Background in atmospheric precipitation ~ 2.8 Tritium Units (TU)
- Weapons testing of 1950s and 1960s increased by 10^3 (1,000 times)
- Present day precipitation had tritium of ~ 10-30 TU
- Tritium is a useful tool for determining a water's age (most immediately < or > 50 years)
- Tritium ranged from <0.1 to 17.6 TU in the study wells
- Lowest tritium values in deep brines and GCG waters
- Highest tritium found in SMI wells and decreases with depth. This implies that groundwater here is <50 years old and has penetrated downward to >22 meters (72 feet)
- Modest amounts of tritium found deep in the DOE ATP-1 nest – suggests possibly younger groundwater traveling through preferential flowpaths?
- Tritiated water (8.7 TU) penetrated to > 22 meters (72 feet) at DOE well SMI-PZ3-D2
- Deep brines and GCG water are tritium free
- Component of younger water to >15 meter (49 feet) depth beneath wetland

^{4}He (from noble gas samples)

- ^{4}He exists as a gas dissolved in water
- ^{4}He comes from radioactive decay naturally occurring U and Th in sediments
- Groundwater acquires ^{4}He by being in contact sediments for long periods of time

- ^{4}He ranged from 0 in shallow modern water to 4.5(10^{-6}) ccSTP/g
- Generally, highest values at site (~2E-6 ccSTP/g) were found in deep brine
- The really interesting part is that ^{4}He appears to delineate a lower boundary to the shallow, more active portion of the aquifer
- The depressed boundary beneath the mill tailings suggests that the shallow groundwater is much younger in age.
- Cross section B-B' has fewer points but shows similar patterns.
- Highest ^{4}He found at Matheson well CR1, 4.5E-6 ccSTP/gm - this elevation above the ~2E-6 ccSTP/g boundary implies a location of upward groundwater flux

Major Findings

- Colorado River is not an absolute hydrologic boundary, in that groundwater in the deep river gravel deposits can travel under both the river and the Matheson Preserve. EFH data and environmental isotopic results also reinforce this interpretation.
- Diffusion is not solely responsible for "mixing" young (contaminated) and old (salty) fluids. Assuming the effective diffusion coefficient (D_{eff}) of the aquifer is 10^{-6} cm^2/s, the mean diffusion length would be ~ 8 meters in 50 years
- The complete or full "extent" of tailings pile groundwater contamination has not yet been defined

GRAPHIC – **General Conceptual Model**

- Flow of groundwater pathways is likely controlled by areas of river channel scour of the shallow overbank deposits. Where river scour has exposed the deep river gravel deposits, groundwater contamination from the tailings pile likely discharges directly to the river. Areas where the river channel has not scoured the shallow overbank deposits, the tailings contamination likely passes under the River and travels under the Matheson Preserve.
- Shallow groundwater system at Matheson Preserve flows in opposite direction, i.e., travels towards and discharges to the river.

Major Uncertainties

- Present rate of contaminant movement and final discharge location(s)
- Hydraulic connection between deep salty contaminated groundwater beneath the tailings/wetlands and alluvial aquifer of Spanish Valley, and the un-quantified potential for groundwater development near Moab to divert contamination and possibly expose people to tailings pollutants.

Final Comment

- While time scale is poorly defined, the wide distribution of river gravel deposits in the subsurface suggest that the river has migrated extensively in the past
- The current regime of the river (sand / silt transport) appears anomalous with respect to the ancestral Colorado River (boulder gravel transport).
- Ammonia is NOT a useful or conservative tracer at this site, in that it appears that biological reactions may control its distribution.

- Sulfate is also NOT a useful tracer at this site in that it occurs naturally in the deep Paradox Formation and exhibits wide ranges of concentrations across the site. As a result, it is difficult to resolve Atlas tailings sulfate from Paradox Formation sulfate.

Kip Solomon: There is a hydrologic connection underneath the river. There are groundwater pathways going underneath the river and into the Matheson Preserve. The highest ammonia concentrations are in the most salty waters. What events led to the deposition of materials (fine grained deposits and river gravels)? Understanding the conditions is important for understanding what is going to happen in the future. The interaction between the deep salty water and the river is very complex and a major issue. This site is the most complex surface water and ground water system he has ever studied.

Dianne Nielson: Perhaps a question we should be asking ourselves is whether or not a monitoring program would be helpful and what it would take to accomplishment it.

2. Need for Additional Groundwater – Surface Water Studies (General Discussion)

Kip Solomon: DOE needs to do more work to understand the groundwater – surface water flow systems. Sulfate (SO_4): Chloride (Cl) ratios across the DOE site and Matheson Preserve demonstrate large ranges of concentrations. Based on available data, it appears that SO_4 cannot be used as a tracer to distinguish tailings SO_4 contamination from natural SO_4 from the Paradox Formation.

3. Resolution of River Migration Issue

Don Metzler: The revised river migration report is available. Three changes to report:

- Carbon-14 (^{14}C) dating of a piece of wood found during drilling (DOE well 435). It is 43,000 years old and was found 113 feet below ground surface. No other ^{14}C dating was done at DOE site because it is difficult to do on diffuse carbon residue in sediments (Joel Berwick).
- It was reviewed by the Army Corps of Engineers. The review is included in the revised report.
- DOE asked the professor at Colorado State University in Fort Collins to review it and her review is included.

DOE's conclusion continues to be that the river is moderately stable to stable. It has potential to migrate, but it will only migrate away from the pile. It is unlikely to migrate toward the pile within the timeframe studied, which is 200 years. We know that the river will flood. We will have an out of bank situation. The Matheson Preserve will be flooded, the toe of the pile will get wet. These scenarios will happen.

Kip Solomon: The DOE report indicates to me that river is migrating toward the pile, as based on the net river migration observed since the 1880's. DOE needs to examine and resolve characteristics of the ancestral and modern Colorado River. Other isotopic dating methods, such as ^{6}Be / ^{10}Al should be considered for age dating the river gravels.

Bruce Waddell: Looks to me like river is moving toward the pile not away from it.

Pete Penoyer: Fine grained (overbank) facies are not found in the deep gravel units, which suggests that these fine materials are not stable in this geologic environment. DOE needs to revise structural contour map to show elevation of top of the deep river gravel deposit. [Don Metzler committed to do this and send email out to Stakeholders when revised map is available on the internet.] Bedrock portals on east and west sides of Moab Valley have existed for ~ 10 million years. The broad extent of the deep river gravels show that the portals have NOT prevented river migration toward or under the tailings pile.

Tom Anderson: Draft EIS does estimate effects and costs of failure scenario where Colorado River undercuts the tailings pile. EIS also looks at salt dissolution related subsidence and its failure consequences.

Toby Wright: Doelling estimated the age of the shallow overbank deposits at 3,000 – 10,000 years. DOE performance goal is 200 – 1,000 years.

4. Future Role of Groundwater Subcommittee (Dianne Nielson)

Don Metzler: DOE is willing to work with the Groundwater Subcommittee in parallel with its ongoing EIS efforts.

Loren Morton: in the long term, 6 – 12 months from now or more, there will still be a need to examine groundwater and surface water related issues at the Moab project.

After discussion, group decided that if there's a reason to meet, the subcommittee will schedule a meeting, with a caveat that what the group really needs to focus on is the EIS. The subcommittee will remain in place. Loren Morton will be the contact.

5. Site Funding Needs (General Discussion)

Don Metzler: DOE is highly constrained under the President Bush's budget and is trying to find cost savings. DOE is working on three projects related to the Moab mill site: the draft EIS, maintaining the site, and interim action and dewatering. Those three things will really tax the Presidents proposed FY04 budget of $2 million. If more funds are available, then more can be done this year. If not, then DOE will be hard pressed to do the three things we are already doing. If DOE gets additional money (beyond the $2 million), Don will do a wish list and coordinate the DOE priorities with the State of Utah.

Dianne Nielson: Grand County (Rex Tanner?) should also be involved in that discussion.

6. Other Issues (General Discussion)

- General Concerns Cooperating Agency Issues: none

- Other Concerns – General Public

John Darke: *What is effect of ice dams on the Colorado River?* We don't know.

Bill Love: two questions (italics):

Will State of Utah express a preferred alternative in its draft EIS comments? [Dianne Nielson responded that it was unknown at this time, however past State comments have been to move the pile.]

With regards to DOE's cost analysis, will DOE distribute the background information for those estimates? [Tom Anderson responded that the detailed cost calculations will be put into the DOE reading rooms (County Libraries), and that some information may not be released because it may complicate or otherwise jeopardize the bidding process.]

Sarah Field: three questions (italics):
Where is the IUC clay borrow source? [Joel Berwick responded that it was at the south end of White Mesa.]
Can the pipeline to White Mesa be left in place? [Joel Berwick responded yes, if it is lined. However, long term fate of the pipe won't be looked at in the draft EIS.]

With regards to the Off-site Alternatives for the tailings pile, does the DOE evaluation consider sale of the property? [Don Metzler responded that DOE will look at it in the draft EIS. However, history of Title I program shows that cleaned up sites have had low commercial value after cleanup. Tom Anderson added that active groundwater remediation will need to go on for 70 –80 years after cleanup.]

Is the DOE engineering stability criteria of 200 – 1,000 years appropriate for a site that is next to a major river? [Paul Mushovic answered that EPA set this time range without considering the half-life of Uranium-238. Don Metzler said that engineering designers always need a time goal. Paul Mushovic retorted that the National Academy of Science had also asked if this timeframe was long enough for this particular environment.]

Rex Tanner: let's coordinate the next Moab Mill Site Stakeholders meeting to coincide with the DOE Cooperators meeting, scheduled for March 2004.